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Indian Standard

AUDIO CORDS AND CORDAGES FOR TELECOMMUNICATION — SPECIFICATION

ICS 29.060.20; 33.040.50; 33.120.20

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1997 **Price Group 4**

Wires, Cables, Waveguides and Accessories Sectional Committee. LTD 18

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Wires. Cables. Waveguides and Accessories Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

This standard covers the requirements and test methods for audio cords and cordages used for telecommunication

For the purpose of deciding whether a particular requirement of this standard is complied with. the final value. observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (***revised***)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
AUDIO CORDS AND CORDAGES FOR TELECOMMUNICATION — SPECIFICATION

1 SCOPE

This standard covers requirements applicable to circular and flat cords with tinsel conductors used for telecommunication such as line cords and telephone cords.

2 REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate-the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1885	Electrotechnical vocabulary :
(Part 32) : 1993	Part 32 Electric cables (*first revision*)
9938 : 1981	Recommended colours for PVC insulation for LF wires and cables
10810	Methods of tests for cables:
(Part 10) : **1984**	Loss of mass test
(Part 11) : 1984	Thermal ageing in air
(Part 18) : 1984	Colour fastness to day-light
(Part 19) : 1984	Bleeding and blooming test
13667 : 1993	Conductors for electronics and Telecommunication application : Tinsel conductors

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1885 (Part 32) shall apply in addition to the following.

3.1.1 *Routine Tests*

Tests carried out on each sample to check the requirements which are likely to vary during production.

3.1.2 *Type Test*

Tests carried out to prove conformity with the requirements of this standard. These are intended to check the general quality and design of a given type of audio cord or cordage.

NOTE — These tests are of such a nature that after they have been made, they need not be repeated unless changes are made in the cable materials, process or design which might change the performance characteristics.

3.1.3 *Acceptance Tests*

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

4 REQUIREMENTS

4.1 Conductors

Conductors shall conform to requirements given in IS 13667.

4.2 Insulation

The conductor shall be covered with an extruded coloured layer of a polymeric insulation material of minimum radial thickness as per Table 1. The polymeric material shall be suitablytreated so that there is no reaction with the conductor material. The insulating material shall have a tensile strength not less than 100 kg/mm^2 and elongation not less than 150 percent.

4.3 Colour

The colour of the cores shall be according to IS 9938. Insulation shall withstand colour fastness test to day light as well as Bleeding and blooming test as per IS 10810 (Part 18) and IS 10810 (Part 19), respectively.

4.3.1 The colour coding of the cores for circular line cords shall be as per Table 2.

4.3.2 The colour coding of circular telephone cords shall be as per Table 3.

4.3.3 Colour coding of flat line cords shall be as per Table 4 and for flat extensible cord as per Table 5.

NOTE — If specified by the purchaser the cores of the flat cords may also be of natural colour.

4.4 Lay up of Insulated Cores

The Insulated cores for circular cords shall be uniformly laid up with an *S* Twist. Non-hygroscopic non-wicking fillers immune to fungal degradation may be used to achieve uniform circular shape of laid up cores. Similar material binder/separator, tape/braid may also be used on laid up cores. for additional physical reinforcement.

Table 1 Dimensions and Resistance of Laid up Cores and Sheath

(*Clauses* 4.2, 4.5.1 *and* 5.2.2)

Tinsel Conductor Type	**Conductor Resistance** (ohm/m)	**Minimum Radial Insulation Thickness** (mm)	**Minimum Thickness of Sheath** (mm)	**Maximum Overall Dia of Insulated Core** (mm)
(1)	(2)	(3)	(4)	(5)
1 15/8	1.15	0.15	*0.65 Round line cords and telephone cords	1.2
1.4/5	1.40	0.10	0.3 Flat line cords and telephone cords	1.1

* On uncoiled round cords.

Table 2 Colour Coding of Cores for -Circular Line Cords

(*Clause* 4.3.1)

No. of Cores	**Colour**									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2 way	Green	Red								
3 way	Green	Red	White							
4 way	Green	Red	White	Blue						
5 way	Green	Red	White	Blue	Orange					
6 way	Green	Red	White	Blue	Orange	Black				
7 way	Green	Red	White	Blue	Orange	Black	Brown			
8 way	Green	Red	White	Blue	Orange	Black	Brown	Slate		
9 way	Green	Red	White	Blue	Orange	Black	Brown	Slate	Yellow	
10 way	Green	Red	White	Blue	Orange	Black	Brown	Slate	Yellow	Violet

Table 3 Colour Coding of Cores for Circular Telephone Cords

(*Clause* 4.3.2)

No. of Cores	**Colour**				
(1)	(2)	(3)	(4)	(5)	(6)
2 way	Green	Red			
3 way	Green	Red	White		
4 way	Red	Red	Green	Green	
5 way	Red	Green	Blue	Slate	Orange

Table 4 Colour Code of Flat Line Cords

(*Clause* 4.3.3)

Way/Position	**Colour**					
(1)	(2)	(3)	(4)	(5)	(6)	(7)
6	Orange	Blue	Green	Red	Black	White
5	Orange	Blue	Green	Red	Black	Void*
4		Blue	Green	Red	Black	
3		Green	Void*	White	Red	
2		Void*	Green	Red	Void*	

* 'Void' position in the above table represents filled sheath material. This is not acceptable for cords with grommet.

Table 5 Colour Codes of Flat Extensible Cords

(*Clause* 4.3.3)

Way/Position	Colour			
(1)	(2)	(3)	(4)	(5)
4	Red	Red	Green	Green

The lay up of the sheath for flat line cords and telephone cords shall be as per Fig. 1.

4.5 **Sheathing/Outer Protective and Covering for Circular Cords (Extruded Sheaths)**

4.5.1 The laid up cores shall be sheathed with a Jacket of uniform polymeric material in single layer of minimum radial thickness as per Table 1. The extruded jacket shall be free from holes, splits, blisters and similar imperfections. A uniform matt finish of the surface of the cord is acceptable.

For flat cordage/cords, one longitudinal fin shall be part of flat surface for identification of polarity of connections and construction shall be as per Fig. 1.

Samples of sheath taken from finished straight cords shall be subjected to tensile test and the tensile strength shall not be less than 10 N/mm² and elongation not be less than 150 percent.

No adhesion shall occur between the insulated cores and also between sheath and the insulated conductor.

After ageing for seven days at 80°C as specified in IS 10810 (Part 11), tensile test shall be carried out and the change in tensile strength shall not be more than ± 20 percent and the change in elongation shall not be more than ● 20 percent.

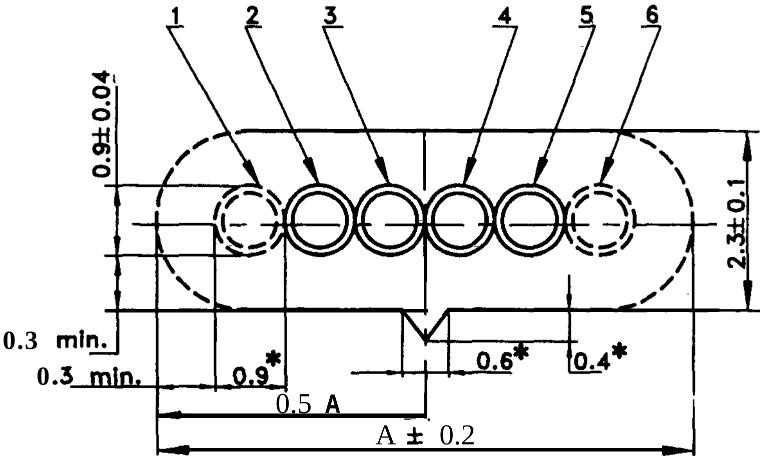
4.5.2 Overall Diameter of round sheathed cord shall be as per Table 6.

Table '6 Overall Diameter of Round Sheathed Cords

No. of Conductor	Maximum Overall Diameter (mm)
(1)	(2)
2	4.2
3	4.5
4	4.8
5	5.2
6	5.6
7	5.8
8	6.8
9	7.0
10	8.0

4.6 **Rip Cord**

In case of circular cords a non-hygroscopic rip cord capable of ripping the sheath shall be incorporated under the sheath for easy removal of sheath while



'A' 4 CORE 4.9±0.1
'A' 6 CORE 6.6k0.1

NOTE — Dimension marked with * are for manufacturer's guidance only.

All dimensions in millimetres.

FIG. 1 LAY UP AND SHEATHING OF CORDS

stripping the same to make terminations.

4.7 Retractable Telephone Cords

4.7.1 *Coiling*

The sheathed cordage shall be coiled to produce a helical cord with *S* twist of internal diameter 8.0 ± 1.5 mm, and processed in such a manner as to cause this form to be maintained during use. The finished cord shall be free from any discoloration or marking as a result of this process. The surface the cord shall be smooth, free from wrinkles, folds and creases. Difference between the maximum and minimum diameter of the finished cords in case of round cords shall not be more than 15 percent of the nominal diameter. Minimum sheath thickness of flat cord shall not fall below 0.3 mm at any point. The fully retracted length of the cord shall not be more than 1/5th of the fully extended length of coiled portion of coiled cords.

4.7.2 *General Dimensions*

The configuration, type and dimensions shall be as agreed between the supplier and the purchaser.

4.8 Terminal Fixing

One or both ends of the cord may be terminated in polarized latching modular plugs.

4.9 Grommet Fixing

The stay hook or fixing grommets shall be fixed or moulded on the cord in such a manner that the same is able to sustain, without any slip, a uniform pull of 50 N along the direction of the cord.

The dimensions of the grommet shall be as per the purchaser's drawing.

5 TESTS

5.1 Classification of Tests

5.1.1 The following shall constitute type tests:

- a) Test on insulation and sheath:
  - i) Tensile strength test (**5.2.13**),
  - ii) Loss of mass on ageing (**5.2.5**),
  - iii) Heat shock test (**5.2.4**),
  - iv) Elongation test (**5.2.6**), and
  - v) Bleeding and blooming tests.
- b) Test on complete cords:
  - i) Adhesive behaviour test (**5.2.7**),
  - ii) Non-marring/non-staining of ABS test (**5.2.8**),
  - iii) Ultraviolet exposure test (for colour other than white and black) (**5.2.9**),
  - iv) Heat test (**5.2.3**),
  - v) Retraction and extension performance test (for coiled cords only):
    - 1) Extension test (**5.2.1**),
    - 2) Retraction test (**5.2.1**),
    - 3) Life performance test (for round coil) (**5.2.2**),
  - vi) Low temperature test (**5.2.10**),
  - vii) Electrical resistance test,
  - viii) Insulation resistance test (**5.2.14**),
  - ix) Dielectric strength test (**5.2.11**),
  - x) Interference rejection test (**5.2.12**),
  - xi) Capacitance test at 1 kHz,
  - xii) Physical test as per drawing of the purchaser, and
  - xiii) Dimension checks.

5.1.2 The following shall constitute acceptance tests:

- a) Physical dimension test,
- b) Retraction and extension test (for coiled cords only) (**5.2.1**),
- c) Electrical resistance test,
- d) Dielectric strength test (**5.2.11**),
- e) Grommet pulling strength test,
- f) Terminal pulling test, and
- g) Flammability test (**5.2.15**).

5.1.3 The following shall constitute routine tests:

- a) Electrical resistance test,
- b) Physical dimension test,
- c) Dielectric strength test (**5.2.11**), and
- d) Insulation resistance test (**5.2.14**).

5.2 Methods of Tests

5.2.1 *Retraction and Extension Test*

5.2.1.1 The following tests shall be performed at 23°C.

The coiled part of the cord under test is stretched to 4 times of its initial length. After this treatment the cord shall be conditioned for 24 h at 23 ± 2°C. The initial length measured in horizontal position shall be 200 ± 10 mm. The cord is suspended in a vertical position with one end secured and the other end to hang freely. A load of 150 g is applied to the free end of the cord. After a period of 30 s, the length of coiled part of the cord is measured. The extended length shall comply with the requirement as specified in Table 7.

After the measurement of the extended length, the load is removed. After further 60 s, the retracted length of the cord is measured which shall meet the requirement as specified in Table 7.

5.2.2 *Life Test for Coil Cords*

The coiled cord which passes the tests specified in 5.2 is fixed at one end of the handset with its grommet mounted at the speaking angle (approximately 45°) to the centre of the life test gadget and the other end is held by a clutch. The coiled cord is stretched in both directions upto four times the coil length of the cord and released. 75 000 such operation will be carried out at the rate of 4 to 6 operations per minute. At the end of the life test, the cord shall be kept at rest far 6 h on a smooth horizontal plane.

After the above period of rest the sheath of the coiled cord shall be examined for presence of crack or any other defects.

Conductor resistance shall meet the requirements of Table 1.

5.2.3 *Heat Test for Coil Cords*

The sample to be tested shall be secured at one of its ends and allowed to lay horizontally for $2^{+0.1}_{-0}$ h in an oven maintained at a temperature of 90^{+5}_{-0}°C. No sign of uncurling, distortion or colour change shall occur after this test.

5.2.4 *Heat Shock Test*

Finished line cord and handset cords shall be capable of passing a heat shock test. Wrap a specimen of each type of finished cord for at least six close turns around a mandrel having a diameter not to exceed two times the nominal diameter over sheath of the finished cords. Suspend the specimen and mandrel in an air oven and condition at 120°C for a period of one hour. When removed from the oven and allowed to cool for one hour and examined with naked eye and the test specimens still on the mandrel neither the jackets nor the underlying conductor insulation shall show any visible crack.

5.2.5 *Loss of Mass on Ageing*

When tested in accordance with IS 10810 (Part 10), the loss on ageing shall not be greater than 1.5 percent.

5.2.6 *Elongatron Test*

A *200* mm sample of the PVC sheath with conductors removed shall be completely immersed: for 16 h in oleic acid at a temperature of 70 ± 1°C. It shall then be lightly rinsed in a 0.5 percent teepol solution at 70 ± 1°C and dried. The sample shall be left for 15 min and then marked with reference lines 50 mm apart.

The samples shall be held at one end and a load equivalent to 7 N/mm² applied at the free end. the load being calculated on the cross-sectional area of the sample which shall be determined by any suitable means.

After one minute the distance between the reference lines shall be measured and the elongation shall be calculated as a percentage of the original distance between the reference lines. Elongation shall be not less than 25 percent.

5.2.7 *Adhesive Behaviour*

A cord specimen, consisting of a protective sleeve withapprox 200 mm length (line cord) and a protective sleeve with several coils (telephone cords), will be stored in desiccator above water at 80 ± 2°C for three days and then dried in hot cabinet at +70°C for 24 h.

The specimen shall not adhere after having been allowed to cool down to room temperature, that is. it shall not feel tacky or some coils shall not stick gently together. There shall not be any change in shade nor any sign of sweating. Over and above, there shall be no considerable change in the coil diameter.

5.2.8 *Non-Marring/Non-Staining of ABS Test*

An assembly is to be made by first placing on the test surface described below short lengths cut from the complete cord, with a cylindrical mandral placed on top of, and at right angles to, these cut lengths. The weight of the mandrel and the number of cut lengths should be such that a pressure of 7 g per cut length of the cord is applied. The test surface is wood or

Table 7 Length of Cord After Retraction and Extension Test

(*Clause* 5.2.1)

No. of Conductors	Maximum Overall Dia (mm)	Internal Diameter of Coil (mm)	Minimum Length for 150 g Load (mm)	Maximum Length After -Retraction (mm)
(1)	(2)	(3)	(4)	(5)
2	4.2	8.0 ± 1.5	an	455
3	4.5		790	425
4	4.8		735	400
5	5.2		680	370

linoleum treated with a clear nitro-cellulose based lacquer or ABS sheet. This assembly is kept for 72 h in an oven at 35°C. At the end of this time, the test surface shall not be marred or sticky.

Convolutions taken from the complete cord are fitted onto a cylindrical mandrel. The weight of the mandrel and the number of convolutions should be such that a pressure of 7 g per convolution is applied.

The fitted mendrel is placed with the convolutions in contract with the wood or linoleum surface treated with clear nitro-cellulose based lacquer. The assembly is kept for 72 h in an oven at a temperature of 35°C. At the end of this period the test surface shall not be marred or sticky.

The colour-of the sheath shall match the standard shade specified in IS 9938 when viewed day light or any kind of artificial light such as that of a tungsten filament or flourescent lamp.

5.2.8.1 *Plasticizer migration*

Styrene copolymers and graft polymers that come into contact with cords and protective sleeves must not sustain damage due to plasticizer.

Cord sheath and sleeve specimens shall be placed on flat polysterene sheets for testing. The cord specimen shall consist of a disk-shaped cross-section taken from the region of the protective sleeve. Each specimen shall be subjected to a load of 50 g and stored in a hot cabinet at 70 ± 2°C for four days. The exposed part of the test sheet will be rubbed off with a clean cotton wad after the specimen and test sheet have been allowed to cool down.

Assessment is to be made at a distance of 30 cm in Natural daylight (Glarefree) in accordance with the details and values indicated in Table 8.

Table 8 Assessment of Plasticizer Migration

Appearance of Test Sheet (1)	Characteristic (2)
No visible alteration	1
Surface shows slight mat appearance	2
Surface shows severe mat appearance	3
Rough surface	4
Scarred surface	5

Characteristics 1 and 2 donate permissible surface alteration.

5.2.9 *Ultraviolet Exposure Test*

A cord specimen consisting of a protective sleeve with Approx 200 mm cord (connecting cord) and a protective sleeve with several coils (handset cord) will be exposed to artificial light in a xenon tester for 120 h.

5.2.9.1 *Light source*

This will be xenon arc lamp having a colour temperature of 5 500 to 6 000 K.

5.2.9.2 *Filter*

A filter serving to reduce the ultraviolet radiation of the xenon arc burner will be positioned between the samples and source of light. It will consist of window glass which features 90 percent transmission at 370 to 380 mm and is completely opaque below 3 10 to 320 mm.

After this treatment the test specimen shall not show by comparison with an unexposed sample, any sign of alteration to the cord sheath or protective sleeve

5.2.10 *Low Temperature Test (Optional)*

A low temperature resistance test as follows shall be carried out.

A coiled handset cord, stored at – 55°C for 2 h, shall be able to extend to 3 times its initial length without the cord body cracking or breaking.

5.2.11 *Dielectric Strength Test*

In complete line and handset cords the insulation between any two conductors shall withstand for five seconds a voltage of 500 V AC, 50 Hz.

5.2.12 *Interference Rejection Test*

Line cords up to 7.92 m in length shall be capable of passing the following lamp interference test when tested in the manner depicted in Fig. 2.

With the lamp circuit as the disturbance source, a maximum of 18 dB cross talk noise shall be measured in the disturbed circuit.

5.2.13 *Tensile Strength*

After seven days of ageing at 80°C of the insulation in an ageing oven under test condition as specified in IS 10810 (Part 11) tensile test shall be carried out and change in tensile strength shall not be more than ±20 percent.

5.2.14 *Insulation Resistance Test*

5.2.14.1 Dry test

The insulation resistance between each conductor and the remainder bunched together and earthed, shall be measured at room temperature with 500V dc after

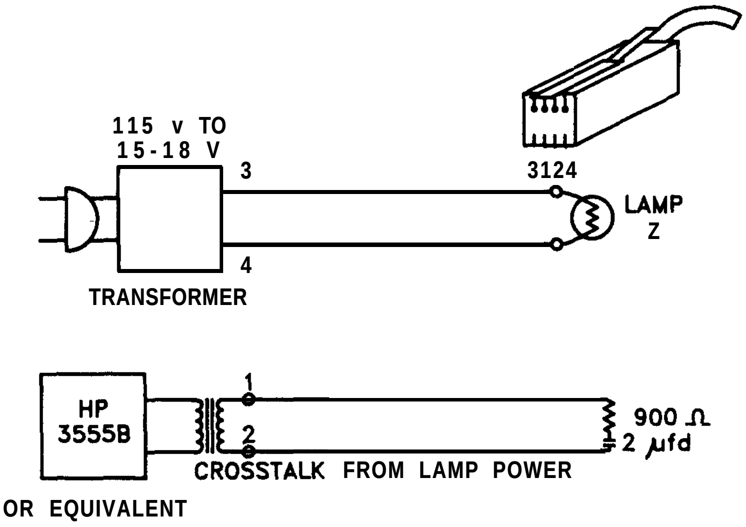


FIG. 2 LAMP INTERFERENCE TEST

electrification for one minute on all cords. The insulation resistance shall be not less than 100 M R/m at 27°C.

5.2.14.2 *Wet test*

Coiled cord shall be immersed in water at 50°C for 2 h. The insulation resistance at 500 V dc after electrification for one minute shall be not less than 50 M Ω/m, when measured between the conductor. and water. while the sample is immersed.

5.2.15 *Flammability Test*

The cord shall be self extinguishing. The test shall be carried out with cord held horizontally on at least two specimen.

6 MARKING

6.1 A label which shall be suitably and securely attached to the audio cord/cordage shall contain at least the following information:

a) Reference to this Indian Standard.
b) Conductor size,
c) Type of cord/cordage (round/flat).
d) Number of cores.
e) Length of cordage (for cordage).
f) Country of manufacture, and
g) Any other information agreed to between the purchaser and the manufacturer

6.2 The manufacturer's identification thread consisting of allotted code shall be incorporated in the outer sheath of laid up cores.

6.3 If required by the purchaser, coloured thread indicating year of manufacture may also be provided under the outer sheath.

6.4 BIS Certification Marking

The cord or cordages may also be marked with the Standard Mark.

6.4.1 The use of Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

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BUREAU OF INDIAN STANDARDS

Headquarters:

Mauak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 33 75

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices: Telephone

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002
323 76 17
323 3841

Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola
CALCUTTA 700054
337 84 99, 337 85 61
337 86 26, 337 86 62

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022
60 38 43
60 20 25

Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600113
23502 16, 235 04 42
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